



## STUCK IN A STACK

Energy flows in tropical building systems

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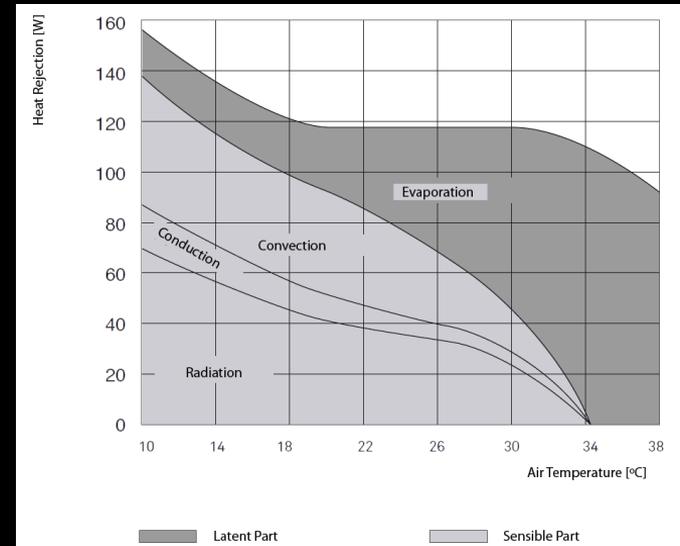
# Heat rejection by human body

Sensible part: Heat from body directly increases the air temperature

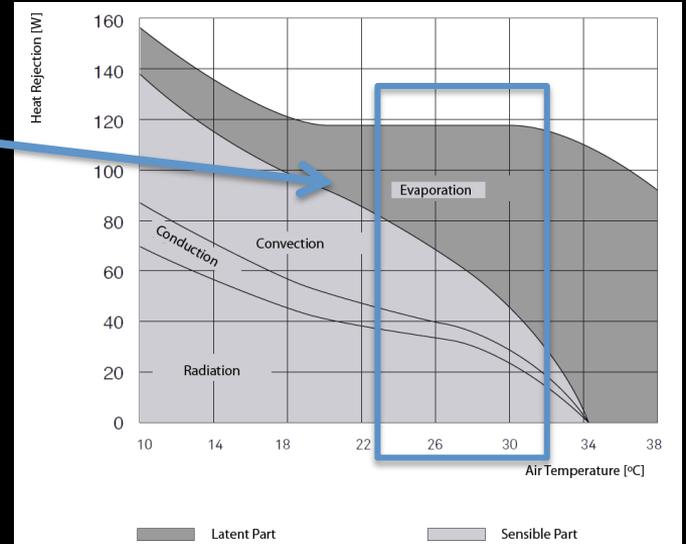
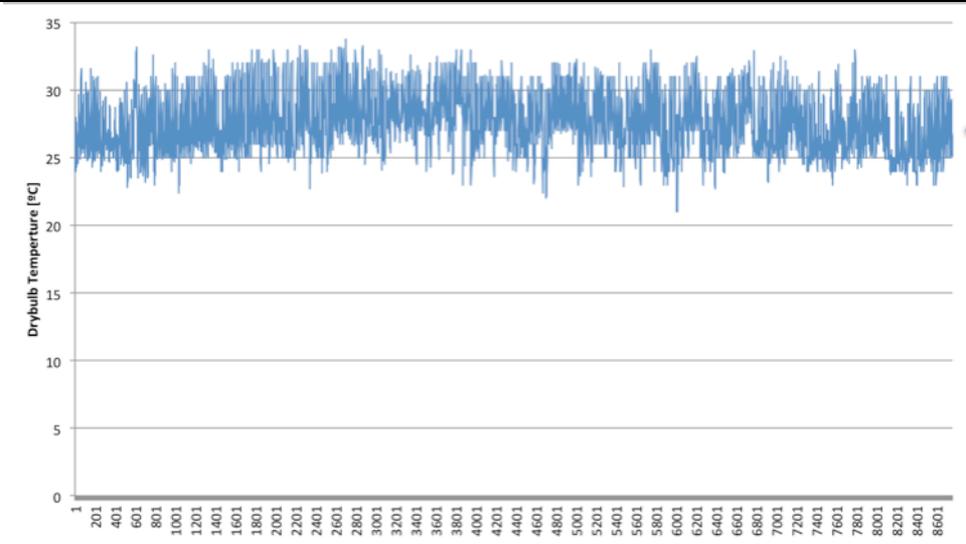
Latent part: Heat is transferred by condensation of water vapour through breathing or skin

Heat rejection rate as a function of air temperature under the following conditions:

- Average person, 70 kg
- Sitting, no physical activity
- Normal clothing
- No air movements



# Temperatures in Singapore



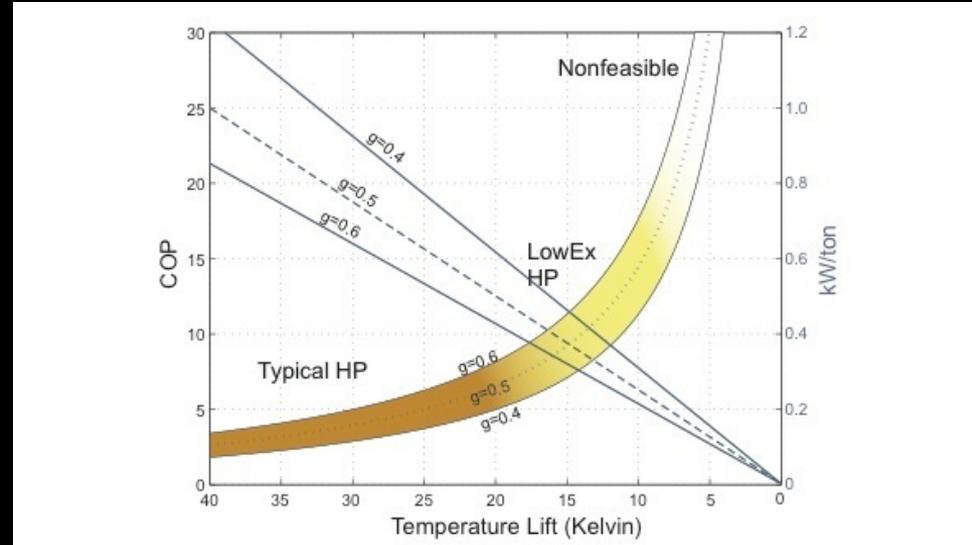
# Traditional vs Tropical Passive House



# Air-Conditioning

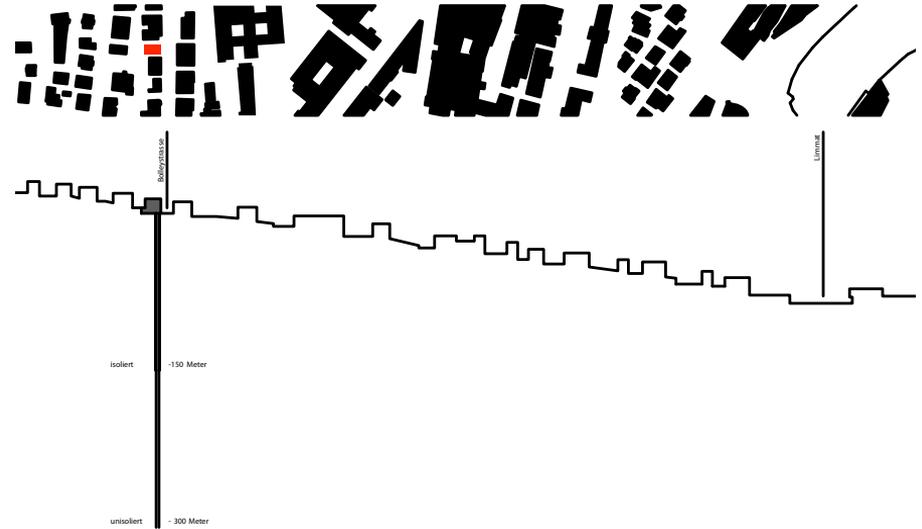


# Temperature Lift and COP

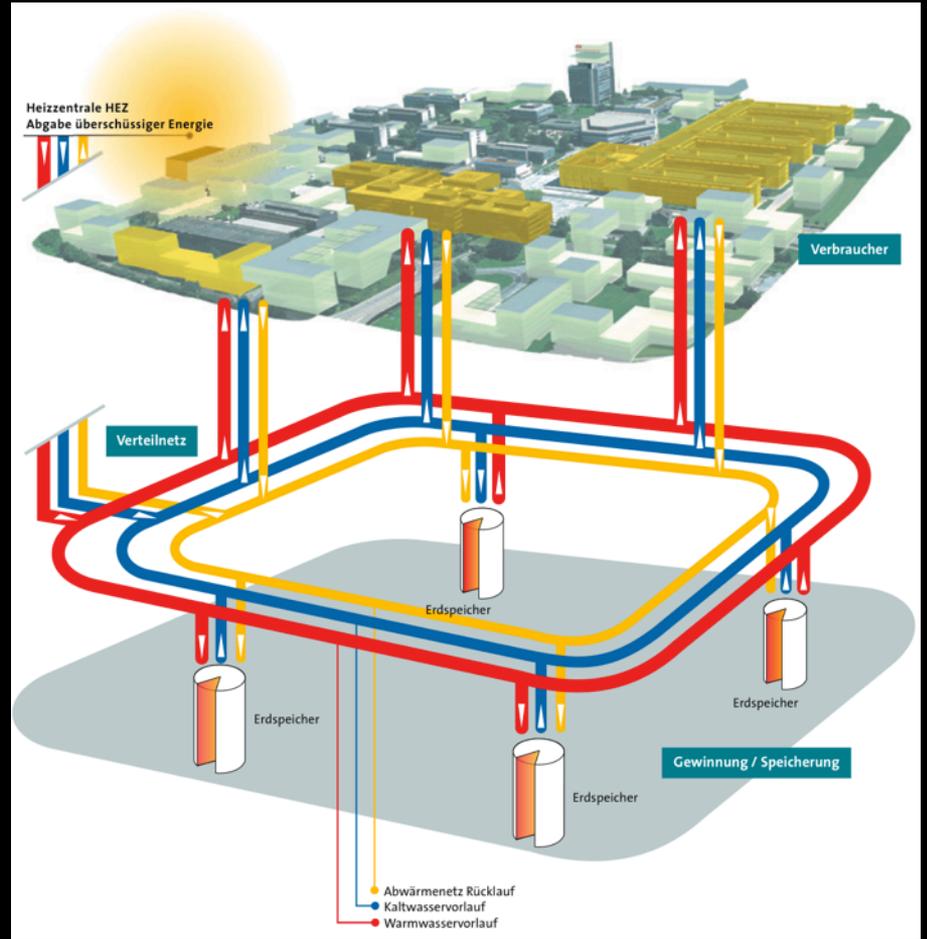


# Heat Pump

Haus B35 in Zürich



# Heat sources/ sinks



# Sol<sup>2</sup>ergie

SolZergie | System für ZeroEmission-Gebäude

[solzergie.org](#)

## SOLZERGIE

Komponenten   Publikationen

Erdeichwärmespeicher	1
Niederhubwärmepumpe	2
Photovoltaik-Hybridkollektor	3
Dezentrale Lüftung	4
Warmwasserproduktion	5

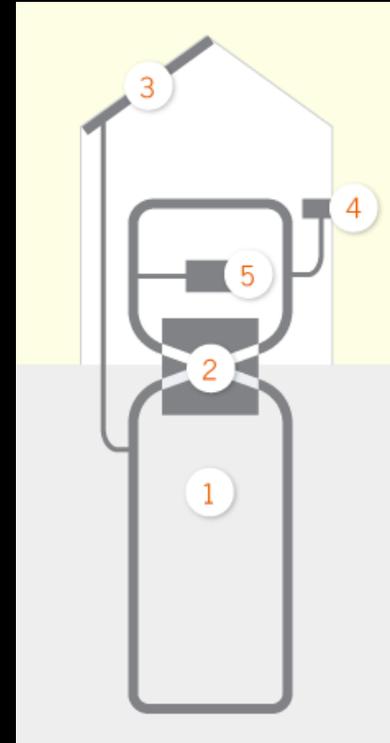


**Energie aus Sonne und Erde**

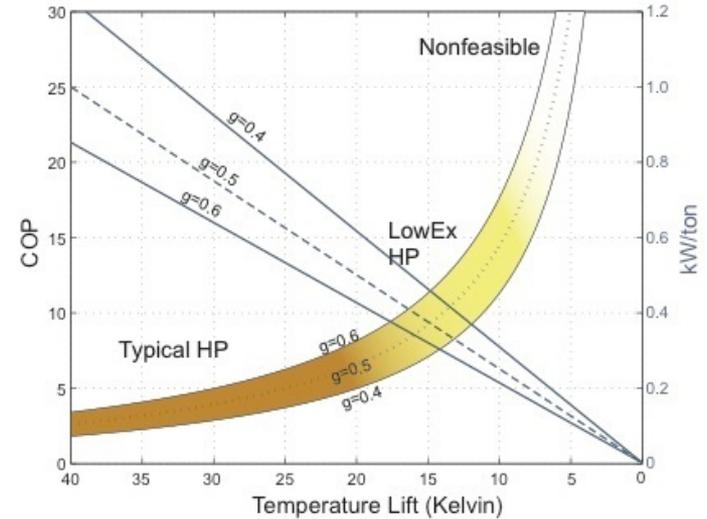
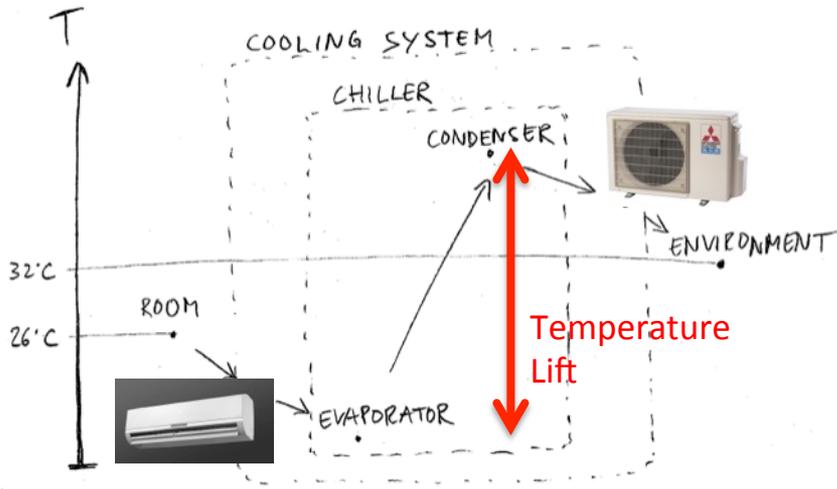
Die solare Energie, die an einem Ort zur Verfügung steht, unterliegt täglichen und saisonalen Schwankungen. Sie muss demnach nicht nur in Wärme und Elektrizität transformiert, sondern auch gespeichert und wieder bezogen werden. Das System SolZergie setzt sich aus tiefer **Erdeichwärmespeicher**, **Niederhubwärmepumpe** und **Photovoltaik-Hybridkollektor** zusammen. **Dezentrale Lüftung** (ohne Wärmerückgewinnung) und **Warmwasserproduktion** ergänzen das Basissystem. SolZergie wird zu einem Zero-Emission-System, wenn der im Winter zugeführte Strom emissionsfrei erzeugt wird.

**Publikationen**

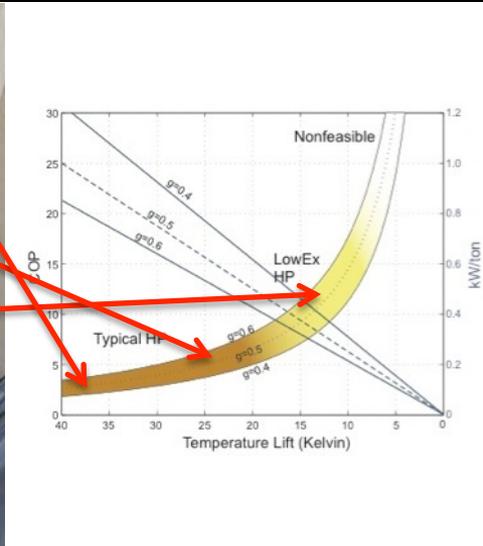
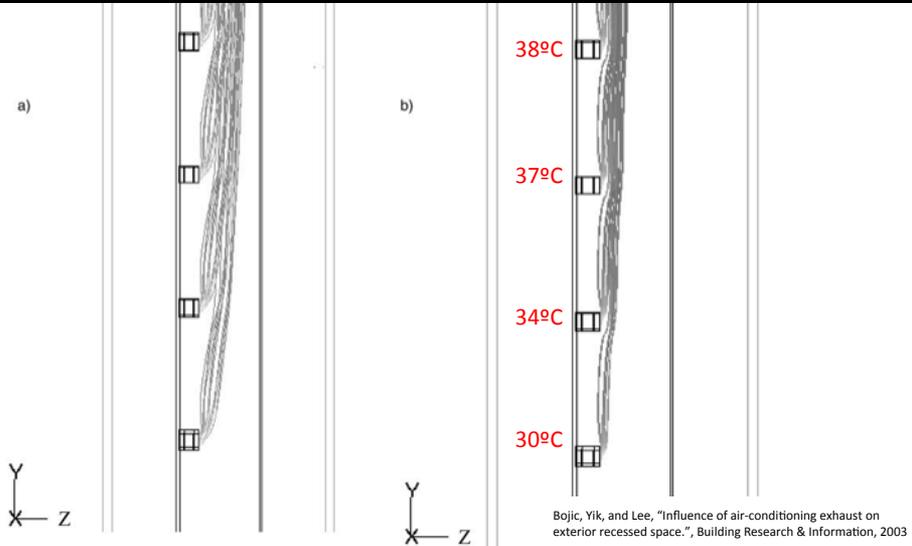
Wollen Sie mehr über SolZergie wissen? Lesen Sie ausgewählte Artikel über das System SolZergie. [Zur Übersicht](#).



# Temperature Lift and COP

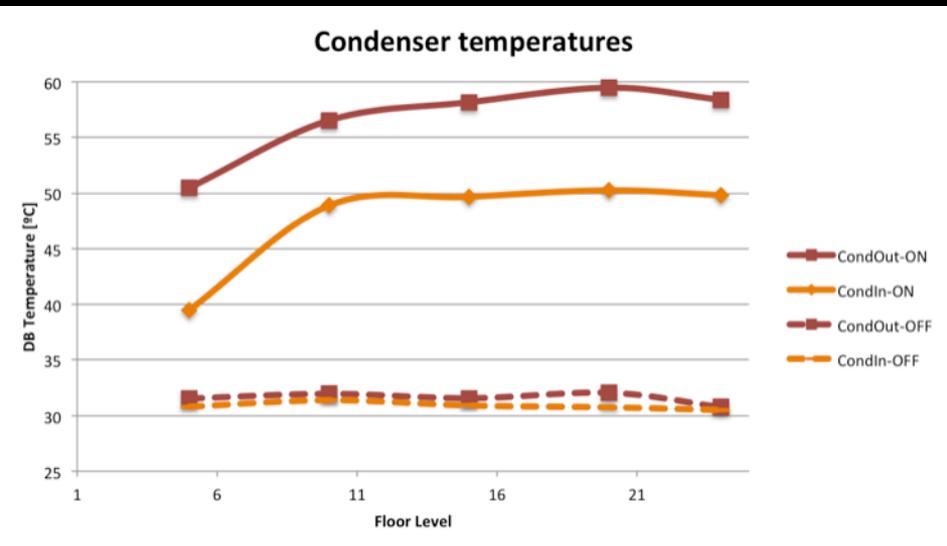
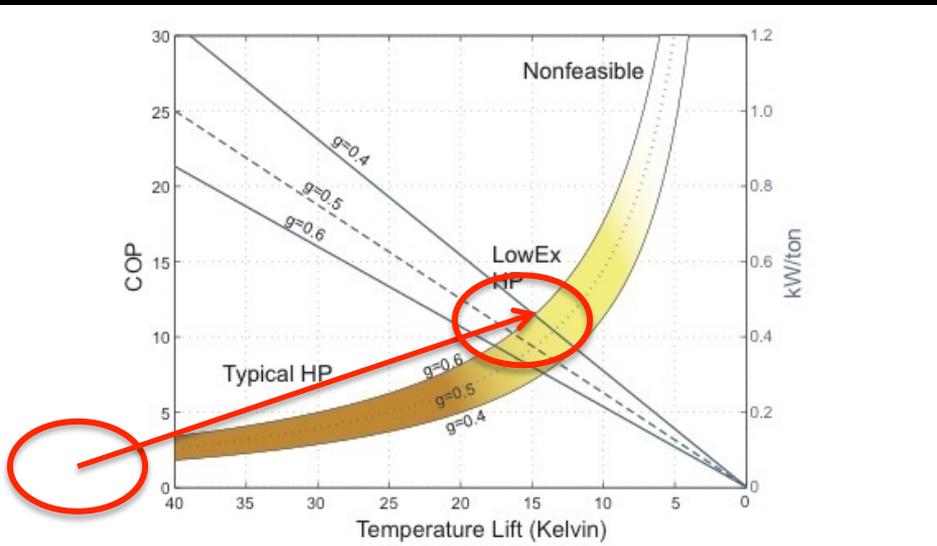


# Stack effect



# NUS Staff Housing: Kent Vale II

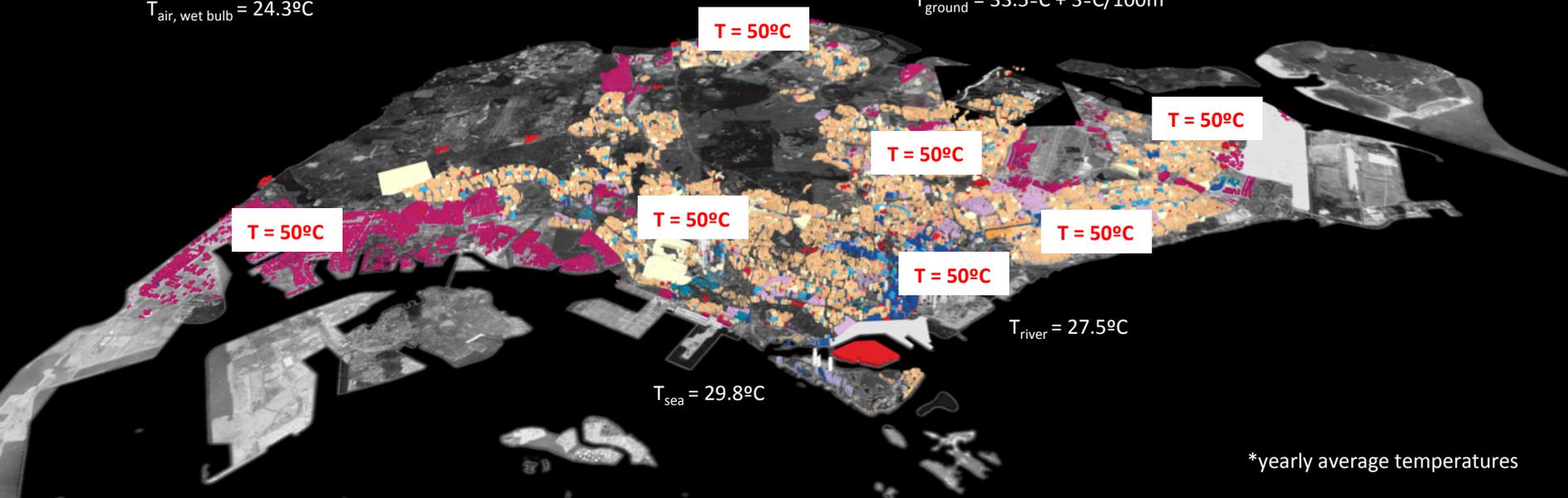




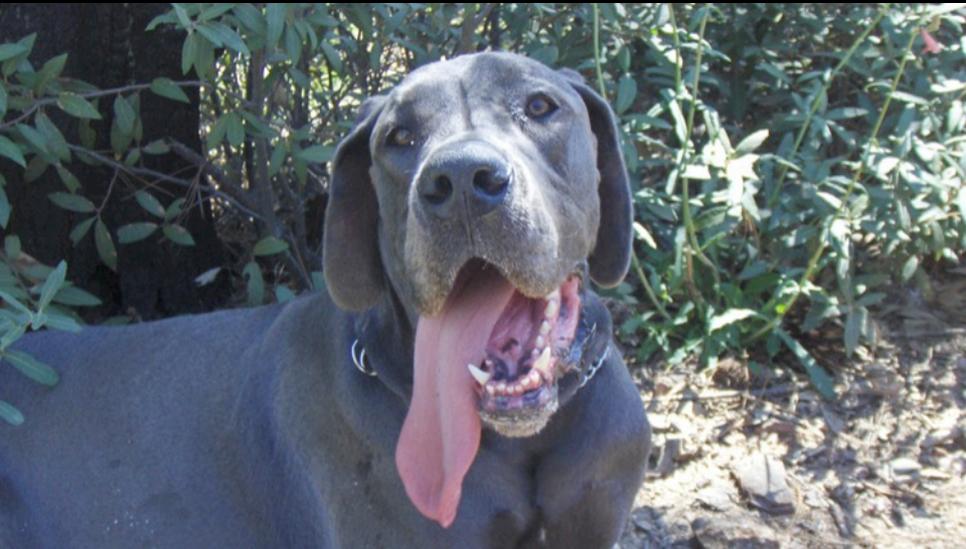
$T_{\text{air, dry bulb}} = 27.5^{\circ}\text{C}$

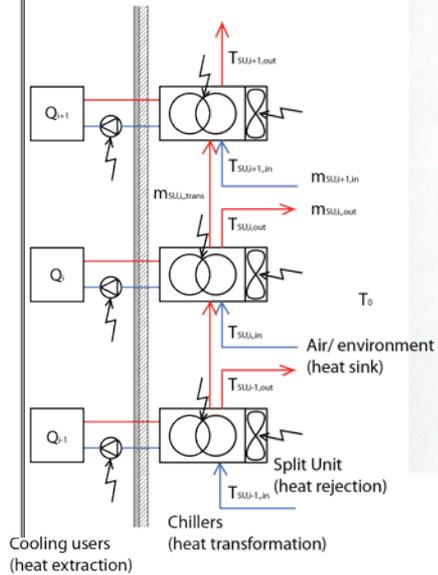
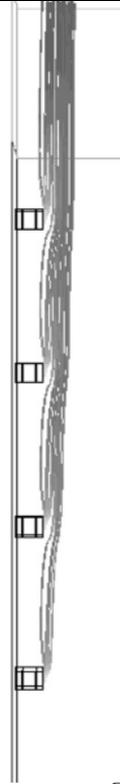
$T_{\text{air, wet bulb}} = 24.3^{\circ}\text{C}$

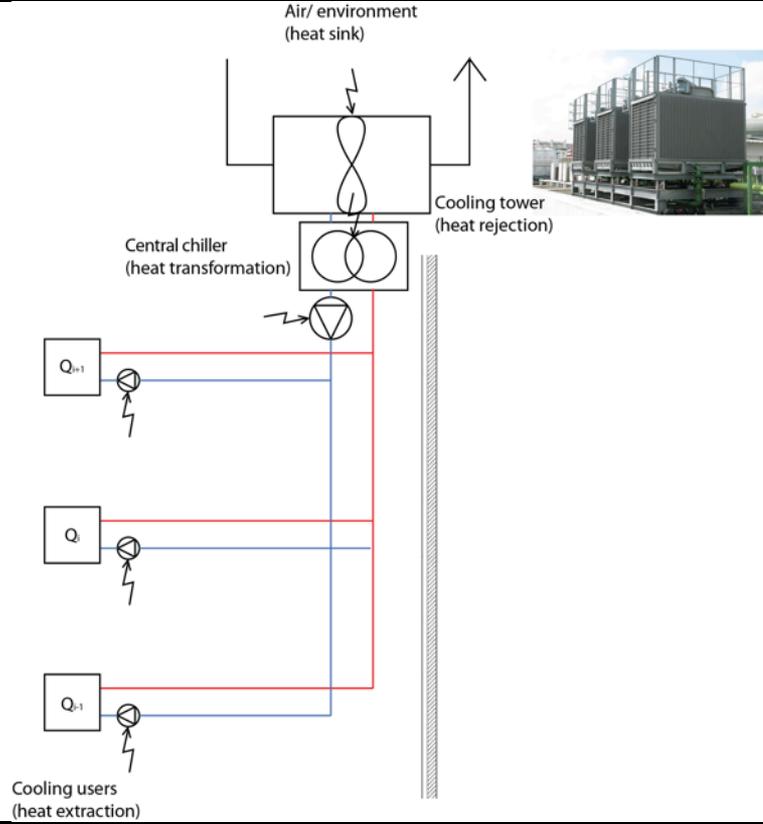
$T_{\text{ground}} = 33.5^{\circ}\text{C} + 3^{\circ}\text{C}/100\text{m}$

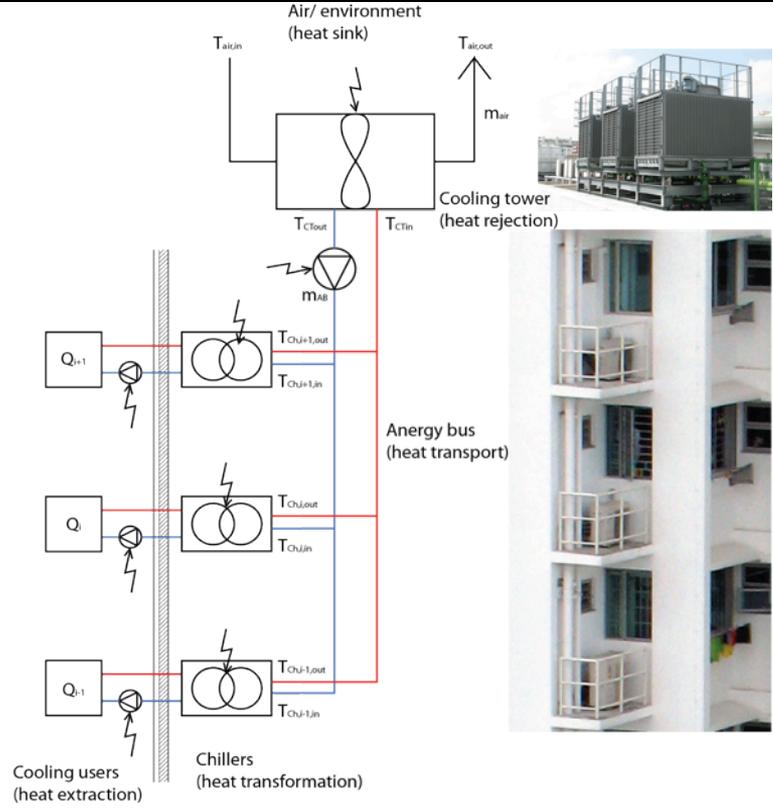


\*yearly average temperatures

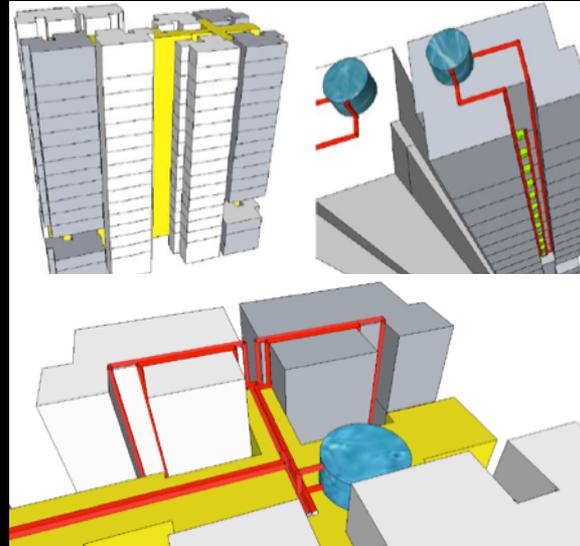








# High-rise housing



# Low-rise shop house / back alleys





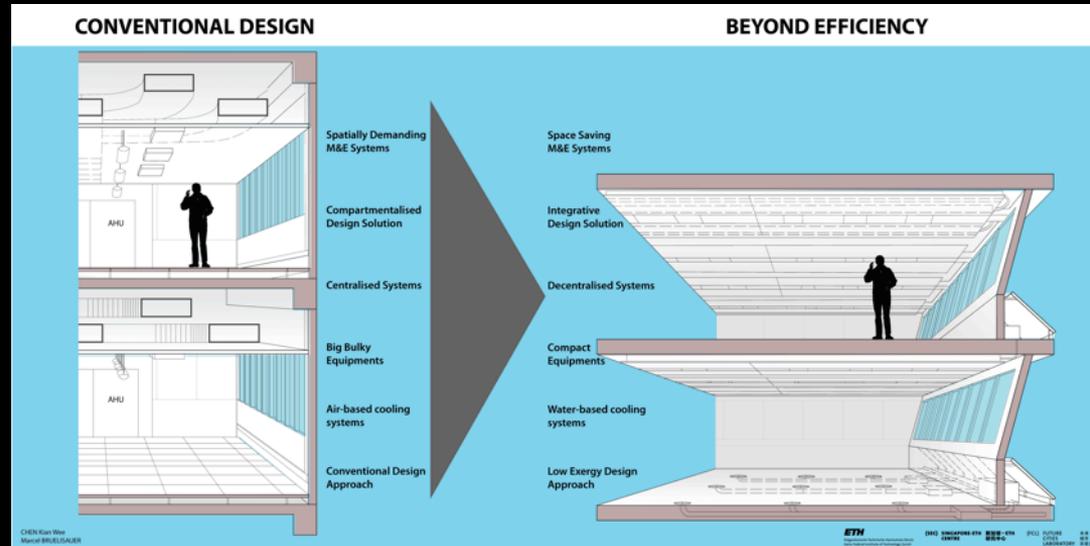
# Questions?

[www.solergie.org](http://www.solergie.org)

[www.busy.arch.ethz.ch](http://www.busy.arch.ethz.ch)

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# Beyond efficiency

